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⑤④発明の名称　リニア誘導モータ式搬送システム

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明　細　書

1．発明の名称

リニア誘導モータ式搬送システム

2．特許請求の範囲

(1).基準面上に支持されるように配置される支持ローラと基準面と異なる高さのガイド面に配置されるガイドローラとを備えた構造体と、前記構造体の両側面に配置された一対のリニア誘導モータと、基準面より下方に配置され、前記構造体に支持されるキャリアとを有する搬送台車と、

各リニア誘導モータに対向して設けられた2次導体と、基準面で支持ローラと接し、支持ローラを支持する支持部材と、ガイド面でガイドローラと接するガイド部材を有し、分岐部においてはリニア誘導モータの吸引力を利用した分岐を行うための磁性2次導体を有する搬送路と、

前記搬送路の分岐部で前記ガイド面内に配置され、搬送路が分岐する際に、少なくとも搬送台車の支持ローラが支持部材を離れている間、関連するガイドローラと接して支持力を発生する分岐部内ガイド部材と

を備えるリニア誘導モータ式搬送システム．

(2).請求項1記載のリニア誘導モータ式搬送システムにおいて、前記搬送路は垂直部材と、該垂直部材の下端に接続し、前記基準面内に配置される第1水平部材と該垂直部材の上端に接続し、前記ガイド面内に配置される第2水平部材とを含む構造部材を有し、垂直部材はリニア誘導モータと対向する2次導体を有し、第1水平部材の上部水平面は支持面を構成し、第2水平部材の垂直内側端面はガイド面を構成する請求項1記載のリニア誘導モータ式搬送システム．

3．発明の詳細な説明

[産業上の利用分野]

本発明は，リニア誘導モータ(LIM)を利用した搬送システムに関し、特に分岐部を有する搬送路上を搬送台車が移動する搬送システムに関する．

［従来技術］

誘導モータを切り開いて展開した構成を有するリニア誘導モータは、給電側である１次側コイルと被給電側である２次側導体がギャップを介して対向する構造を有する。１次側に交流電流を流して作る進行磁界と、この進行磁界により２次側導体上に生じる渦電流により推力を発生する。２次側には導体と磁性体とを組み合わせて用いることも多い。１次側、２次側のどちらを可動とすることもでき、パレット搬送装置等に用いられる。

搬送路が分岐部を有する搬送システムの分岐方式として、たとえば、シフタ方式とターンテーブル方式が知られている。

シフタ方式は、第６図に示すように、分岐部に、図面中左右方向に移動可能に図示された、シフタ５０を設け、その上に２種類以上の分岐レール５１及び５２を設ける。たとえば、シフタの一側にはレール５３、他側にはレール５４，５５が配置されている。搬送台車（図示せず）がレール５３とレール５４との間を移動する場合は、シフタ５０を左方向へ移動して、シフタ５０上の右側レール５１をレール５３とレール５４との間に配置して両レールを接続する。レール５３からレール５５へ移動する場合は、シフタ５０を右方向へ移動させ、シフタ５０上の左側のレール５２でレール５３とレール５５を接続する。シフタの両側でレール数が１対２の場合を示したが、一般的には、ｎ：ｍでよい。作業工程上は、安全上搬送台車がシフタの近くまで来てから、搬送台車を停止させ、シフタを希望位置に移動してから搬送台車を再駆動する。

第７図はターンテーブル方式の分岐部を示す。回転可能なテーブル６０上のレールはテーブル６０に接する搬送路レール６１，６２，６３のいずれにも接続可能である。搬送台車６４を一旦このテーブル６０上のレールに載せ、このテーブル６０の回転により、搬送台車６４の進行方向を変える。分岐部に３通りのレールが会合する場合を示したが、任意のｎ通りのレールが会合してもよい。搬送台車はテーブル上で停止させる必要があり、一般的にテーブルの前で搬送台車を一旦停止させ、ゆっくりとテーブル上に載せる。

［発明が解決しようとする課題］

このような従来の搬送装置の分岐方式では、通常搬送台車を分岐部の手前で一旦停止させた後、分岐動作を開始させる。また、第７図の場合は分岐部内においてもターンテーブルの回転を行うための時間が必要である。このためサイクルタイムがさらに長くなる。

また、分岐部内に可動機構があるのでそのメインテナンスが必要となり、故障の原因となる。

本発明の目的は、分岐部での搬送を迅速に行い、サイクルタイムを短縮することができるリニア誘導モータ式搬送システムを提供することである。

本発明の他の目的は、分岐部内に可動機構を必要としないリニア誘導モータ式搬送システムを提供することである。

［課題を解決するための手段］

本発明のリニア誘導モータ式搬送システムによれば、支持ローラが支持される基準面より上方にガイド面が設定され、ガイド面内にガイドローラと分岐部ガイド部材とが配置される。搬送路の交差部で基準面内の支持ローラが支持を失った時、ガイド面内のガイドローラが分岐部ガイド部材と係合し、支持を確保して、搬送台車の落下を防止する。

第１図（Ａ），（Ｂ），（Ｃ）に本発明の基本概念を示す。

第１図（Ａ）を参照して説明すると、通常時の搬送システムは、フレーム９ａと、その両側面に配置されたリニア誘導モータ２ａ，２ｂと、フレーム９ａに支持された支持ローラ４ａ，４ｂ及びガイドローラ３ａ，３ｂとを有する搬送台車１と、各リニア誘導モータに対向して設けられた２次側導体５ａ，５ｂと、支持ローラ４ａ，４ｂを支持する支持部材７ａ，７ｂと、ガイドローラ３ａ，３ｂと接するガイド部材６ａ，６ｂを有する搬送

路１０とを有する．なお、図示していないが支持ローラの４ａ、４ｂの後方には支持ローラ４ｃ、４ｄがあり、ガイドローラ３ａ、３ｂの後方にはガイドローラ３ｃ、３ｄがあるものとする．

さらに、第１図（Ｂ）に示すような搬送路１０の分岐部に於いては、分岐する搬送台車１の連結部材９ｃの通過を許すためには点線で示す部分に支持部材は配置できない．すると、そのままでは搬送台車の支持ローラの一方、たとえば４ｂは支持を失い、搬送台車１が落下してしまう．

第１図（Ｃ）に示すように、搬送台車１が搬送路１０ｂに分岐する際に分岐方向に対して反対側のガイドローラ３ｂと接するように分岐部ガイド部材８ｂが基準面より上のガイド面内に設けられる．同様に、搬送路１０ｃに分岐する際のための分岐部ガイド部材８ａが設けられている．

搬送路１０は垂直部材５ａ、５ｂと該垂直部材の上下両端に接続する上水平部材６ａ、６ｂと下水平部材７ａ、７ｂとを有するコの字またはＩの字形の断面を有する搬送路部材を有し、垂直部材５ａ、５ｂはリニア誘導モータ２ａ，２ｂと対向する導体を有し、下水平部材７ａ，７ｂの上面は支持ローラ４ａ，４ｂの支持面を形成し、上水平部材６ａ，６ｂの端面はガイドローラ３ａ，３ｂに対するガイド面を形成するのが好ましい．

〔作用〕

第１図（Ｂ）を参照して説明すると、上述のような搬送路部材により構成される搬送路１０ａ上を下方に向かって分岐部の手前まで走行してきた搬送台車１を、分岐の１方向（たとえば第１図（Ｂ）の左側の搬送路１０ｂ）に進行させる場合、第１図（Ａ）の分岐方向のリニア誘導モータ２ａを励磁したまま反対側のリニア誘導モータ２ｂの励磁を切る．励磁されたリニア誘導モータ２ａは推力と共に吸引力を発生し、搬送台車１を２次側導体５ａ方向（図中左方向）へ方向付ける．このようにして、第１図（Ｃ）で示すように、幅の広くなった分岐部において、搬送台車１は左方の２次側導体５ａに沿って移動する．

交差部内側では搬送路の支持部材は切り欠かれているのでそこで支持ローラは支持を失う．しかし、基準面と異なる高さのガイド面内に設けられたガイド部材８ａ，８ｂがガイドローラ３ａ、３ｂと当接して支持力を発揮することにより搬送台車１は保持される．図示の場合、前方右側の支持ローラ４ｂが支持部材７ｂを外れる前に、ガイドローラ３ｂが分岐部ガイド部材８ｂに当接する．前のガイドローラ３ｂが分岐部ガイド部材８ｂに係合した後、支持ローラ４ｂが支持を失う．また後方右側の支持ローラ４ｄが支持を失う前にガイドローラ３ｄが分岐部ガイド部材８ｂに当接する．このようにして搬送台車１が搬送路１０ａから搬送路１０ｂに移行する．この間主として右側のガイドローラ３ｂ，３ｄ及び左側の支持ローラ４ａ，４ｃはそれぞれ分岐部ガイド部材８ｂ及び支持部材７ａと当接している．

支持ローラ４ｂ，４ｄと支持部材７ｂとの係合、ガイドローラ３ｂ，３ｄと分岐部ガイド部材８ｂのガイド面の係合の全てが失われないかぎり、搬送台車１は落下しないように設計することができる．

また、少なくとも上述の４つの係合のうち２つは保持されるように設計することもできる．ガイドローラを小さくすると、上方の水平部材６と分岐部ガイド部材８とのギャップを小さくすることができる．

〔実施例〕

以下、図面を参照して本発明の実施例を説明する．

第２図（Ａ）および（Ｂ）は本発明の一実施例によるリニア誘導モータ式搬送システムに用いる搬送台車を示し、第２図（Ａ）は第２図（Ｂ）のⅡＡ－ⅡＡ線に沿う矢視正面図、第２図（Ｂ）は第２図（Ａ）のⅡＢ－ⅡＢ線に沿う矢視平面図である．これらの図において、搬送システムは搬送台車１１と搬送路１０を含み、搬送台車１１は搬送路１０に沿って走行して部品等の被搬送物（図示せず）を搬送する．

搬送台車１１は、フレーム１９ａと、フレーム１９ａの両側面に設けられたリニア誘導モータ（ＬＩＭ）１２ａ，１２ｂと、部品等の被搬送物を収容するキャリア１９ｂと、キャリア１９ｂをフレーム１９ａに吊下げる連結部材１９ｃを有する。リニア誘導モータ１２は鉄心等の磁心とコイルを含み、三相交流電流で駆動されて進行磁場を発生する。フレーム１９ａは下部に主たる支持力を与える大径の支持ローラ１４を有し、さらに上方に小径の上ガイドローラ１５、下方に同じく小径の下ガイドローラ１６が設けられて、その水平方向位置を正確に定めている。第２図（Ｂ）の平面図より明らかなようにこれら支持ローラ１４及びガイドローラ１５、１６は、それぞれ搬送台車１の前後左右に４個ずつ設けられる。

搬送路１０は、２本のＩ形断面を有するＩ型部材３０ａ，３０ｂを有する。各Ｉ形部材３０ａ，３０ｂは垂直部材２５ａ，２５ｂと、この垂直部材２５ａ，２５ｂの上下に固定された２つの上水平部材２６ａ，２６ｂと，下水平部材２７ａ，２７ｂを有し、上水平部材２６ａ，２６ｂが屋内架台３５に固定される。垂直部材２５ａ，２５ｂはアルミニウム等の導体と鉄等の磁性体を有し、リニア誘導モータ１２ａ，１２ｂと対向してリニア誘導モータ１２ａ，１２ｂの２次側導体を構成する。なお、垂直部材２５は、必ずしも磁性体を含まなくてもよいが、少なくとも分岐部周辺においては吸引力を発生させるために鉄などの磁性材料を含むことが必要である。

搬送台車１１の支持ローラ１４は、Ｉ形部材３０の下水平部材２７ａ，２７ｂの上面２４ａ，２４ｂに支持されて、搬送台車１を支持する。また、上ガイドローラ１５は上水平部材２６ａ，２６ｂの内側端面２８ａ，２８ｂに当接し、下ガイドローラ１６は下水平部材２７ａ，２７ｂの内側端面２９ａ，２９ｂに当接してリニア誘導モータ１２と２次側導体２５との間のギャップを一定に保っている。

搬送台車１１はさらに、図示しない集電装置、制御装置等を有する。集電装置は搬送路１０あるいはＩ形部材３０に設けられる図示しないトロリ線から交流電圧を取り入れる。

なお、Ｉ形断面を有するＩ形部材を用いる場合を説明したが、Ｉ形部材の代わりに、コの字形部材を両側から付き合わせるように用いてもよい。同様に、垂直部材の上方には両側に突出する水平部材を有し、下方に内側にのみ突出する水平部材を有する構造材を用いることもできる。

本実施例の場合、上下に案内部材を設けたことにより、搬送台車の運動が安定化される。

Ｙ字形等の分岐点において、搬送台車の通過のため搬送路の支持面を切り欠き、切り欠き部で支持車輪が一部支持を失う構成にした時、以下に説明するように、上案内車輪を上水平部材の端面と係合させておくことにより支持力を確保し、搬送台車が落下することを防ぐことができる。

第３図（Ａ），（Ｂ）第４図（Ａ），（Ｂ）は搬送路１０の分岐部の１形態を示す。第３図（Ａ）（Ｂ）が正面縦断面図で第４図（Ａ），（Ｂ）中ⅢＡ－ⅢＡおよびⅢＢ－ⅢＢの線に沿う矢視図、第４図（Ａ），（Ｂ）は平面断面図で第３図（Ａ）（Ｂ）のⅣＡ－ⅣＡおよびⅣＢ－ⅣＢの線に沿う矢視図である。

第３図（Ａ）は単独搬送路の部分の縦断面図、第３図（Ｂ）は分岐部分の縦断面図である。分岐部分に差し掛かると両側のＩ形部材３０ａ，３０ｂが離れ、間隔が広くなる。分岐部においては、上水平部材２６ａ，２６ｂが画定するガイド面内に分岐部ガイド部材３６，３８が設けられる。搬送台車１１の上ガイドローラ１５と当接する分岐部ガイド面３７，３９をその側面に形成して、支持を与える。

第４図（Ａ）は第３図（Ａ），（Ｂ）のⅣＡ－ⅣＡ線で示した上水平部材内を通るガイド面から下方を見た平面図である。搬送路１０ａから搬送路１０ｂ，１０ｃが分岐しており、上水平部材２６ａと２６ｂとが次第に離れ、新たに上水平部材２６ｃ，２６ｄが設けられている。分岐部内には、上述の分岐部ガイド部材３６，３８が設けられている。これらの分岐部ガイド部材は上水平部材が

なくなる部分で、上水平部材と同等の役割を果たそうとするものである。

第４図（Ｂ）は第３図（Ａ），（Ｂ）のⅣＢ－ⅣＢ線に沿う中間面から下方を見た平面図であり、下水平部材の支持面の形状を示す。下水平部材２５は上水平部材２６と同様の形状を有する。第２図（Ａ）に示す連結部材１９ｃのような部材の通過を許すため、分岐部の中央部は何もない空間であり、第４図（Ａ）に示した分岐部ガイド部材に対応する部材を配置することはできない。

次に、第５図（Ａ），（Ｂ），（Ｃ）を参照して、以上の構成を有する搬送システムにより、搬送台車１１がＩ形部材３０ａ，３０ｂにより構成される搬送路１０ａからＩ形部材３０ｄ，３０ｂにより構成される搬送路１０ｃへ分岐する際の動作を説明する。

搬送路１０ａ上を分岐部の手前まで走行してきた搬送台車１１の、分岐方向（図の場合は下側）のリニア誘導モータ（第２図（Ａ），（Ｂ）１２ｂ参照）を励磁したまま反対側のリニア誘導モータ（第２図（Ａ），（Ｂ）１２ａ参照）の励磁を切る。すると、第５図（Ａ）に示すように、励磁されたリニア誘導モータ１２ｂは推力と共に吸引力を発生し、搬送台車１を下方へ移動させる。前方右側のガイドローラ１５ａがＩ形部材３０ａのガイド面から離れて、すぐに分岐部ガイド部材３６に当接する。ガイドローラ１５ａが分岐部ガイド部材３６に当接する時には、まだ前方右側の支持ローラ１４ａが支持面３０ａから脱輪していないように支持ローラ１４、ガイドローラ１５の取り付け位置を設計しておく。

前方右側のガイドローラ１５ａによって搬送台車１１の重力を支えて進行していくと、第５図（Ｂ）に示すように、後方右側のガイドローラ１５ｃがＩ形部材３０ａのガイド面から離れ、直ぐに分岐部ガイド部材３６と当接する。

次いで，第５図（Ｃ）に示すように、前方右側のガイドローラ１５ａがＩ形部材３０ｄのガイド面に当接し、搬送台車１１は搬送路１０ｃに入る。最後に、後方右側のガイドローラ１５ｃがＩ形部材３０ｄのガイド面に当接して、搬送台車１１が完全にＩ形部材３０ｂ，３０ｄにより構成される搬送路１０ｃに移行する。この間、左側のガイドローラ１５ｂ，１５ｄ及び左側の支持ローラ１４ｂ，１４ｄはそれぞれ常にＩ形部材３０ｂのガイド面及び支持面と当接している。このようにして、搬送台車１が落下することなく分岐部を進行することができる。

以上図面に示した実施例に基づいて本発明を説明したが、本発明はこれには限定されず、請求項に記載した範囲内で種々変形可能である。

例えば、搬送路を２つのＩ形部材で構成したが、２つのコの字形部材や他の構造の部材で構成することもできる。搬送台車の支持方式として支持ローラを用いる場合を説明したが、他の支持方式例えばエアベアリグ、磁気ベアリングなどを用いてもよい。

また、ガイドローラ１５、１６が、搬送台車のフレーム１９ａに設けられている例を示したが、直接リニア誘導モータ１２に設けてもよい。キャリア１９ｂの支持方式として懸架式のものを示したが、内臓式等のものでもよい。

［発明の効果］

本発明のリニア誘導モータ式搬送システムによれば、搬送路の分岐部の手前あるいは分岐部内で搬送台車を停止する必要がないので、搬送台車が迅速に分岐部を通過することができ、サイクルタイムを短縮することができる。

また、分岐部に可動機構部がないのでメインテナンスを必要とせず、かつ搬送台の分岐部での走行を確実に行うことができる。

４．図面の簡単な説明

第１図（Ａ），（Ｂ），（Ｃ）は本発明の基本概念を示す図であり、第１図（Ａ）と（Ｃ）は通常時と分岐時の正面図、第１図（Ｂ）は分岐部の平面図、

第２図（Ａ），（Ｂ）は本発明の実施例による搬送システムに用いる搬送台車を示す図で、第２

図（Ａ）は正面図、第２図（Ｂ）は平面図。

第３図（Ａ）、（Ｂ）は搬送路の断面構造を示し、第３図（Ａ）は単独搬送路部分、第３図（Ｂ）は分岐部の断面図。

第４図（Ａ）、（Ｂ）は搬送路の平面構造を示し、第４図（Ａ）はガイド面の平面図、第４図（Ｂ）は支持面の平面図。

第５図（Ａ）、（Ｂ）、（Ｃ）は搬送台車が分岐部を通過する際の動作を説明するため、３つの状態を示す平面概略図。

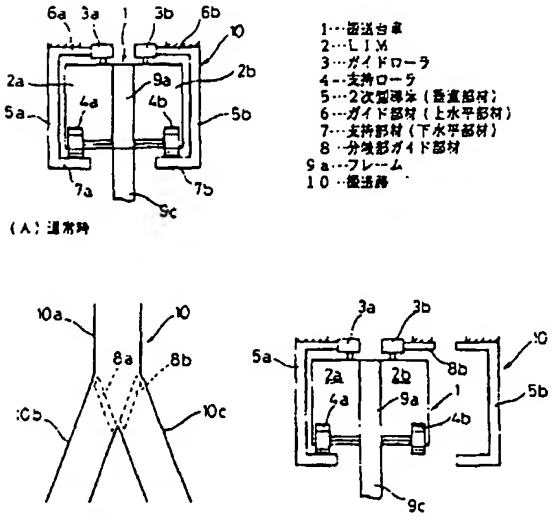
第６図は従来の搬送装置の分岐方式の一例を示す平面図。

第７図は従来の分岐方式の他の例を示す斜視図である。

図において、

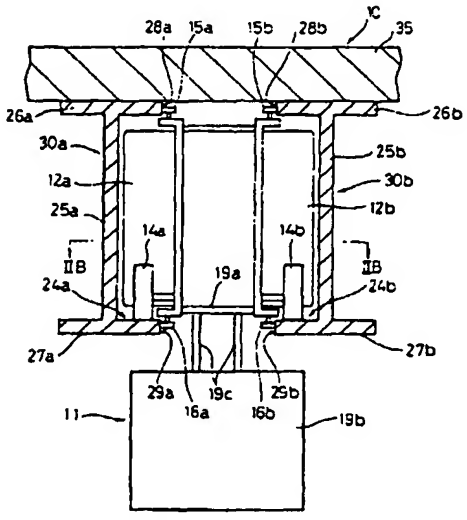
1	搬送台車、
2	ＬＩＭ
3	ガイドローラ
4	支持ローラ
5	２次側導体（垂直部材）
6	ガイド部材（上水平部材）
7	支持部材（下水平部材）
8	分岐部ガイド部材
9a	フレーム
10	搬送路
11	搬送台車
12	ＬＩＭ
14	支持ローラ
15	上ガイドローラ
16	下ガイドローラ
19a	フレーム
19b	キャリア
25	垂直部材
26	上水平部材
27	下水平部材
28,29	端面（ガイド面）
35	屋内架台
36,38	分岐部ガイド部材

復代理人　弁理士　高橋敬四郎



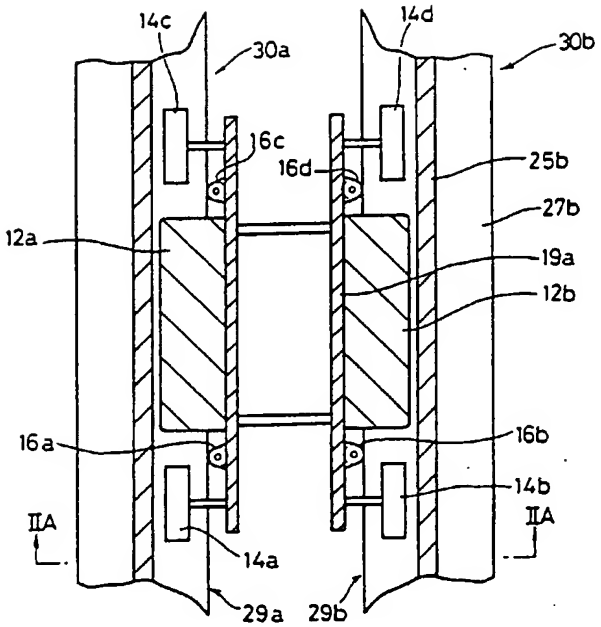
（Ａ）通常時　（Ｂ）分岐部搬送路　（Ｃ）分岐時

本発明の基本概念
第１図



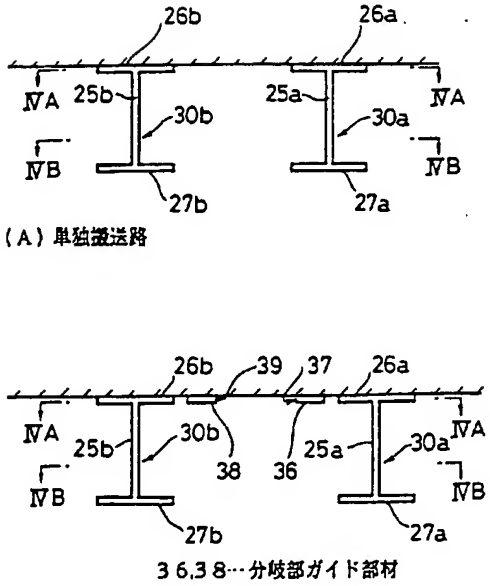
（Ａ）正面図

本発明の実施例による搬送台車
第２図（その１）

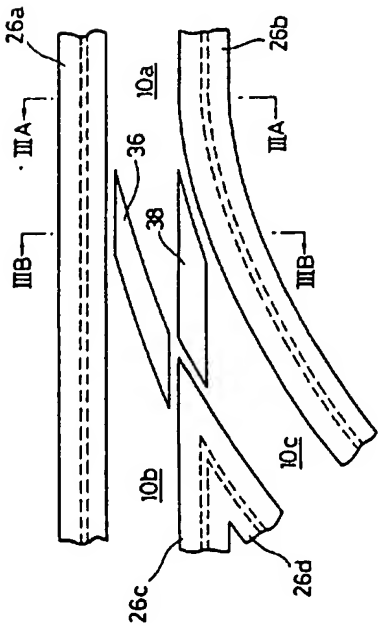


(B) 平面図

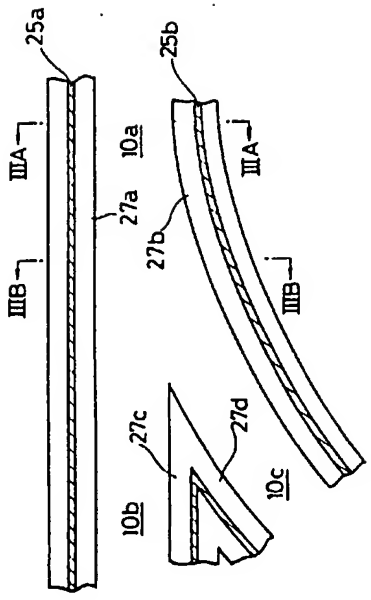
本発明の実施例による搬送台車
第 2 図(その2)



搬送路断面構造
第 3 図

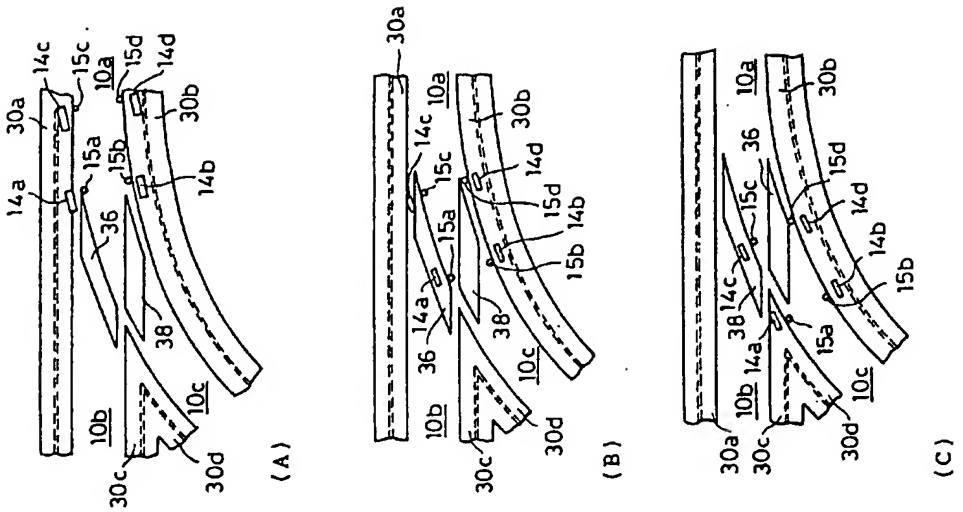


(A) ガイド面平面図

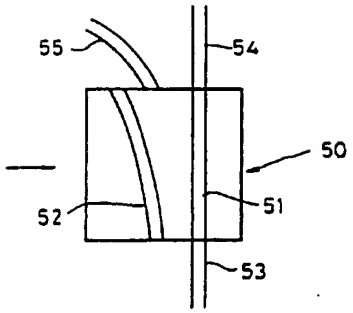


(B) 支持面平面図

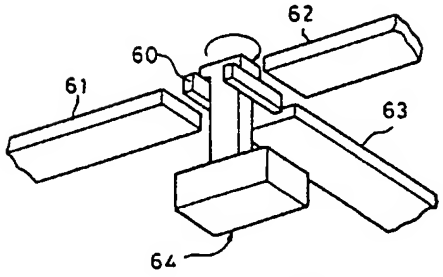
搬送路平面構造
第 4 図



分岐点での搬送台車の支持
第 5 図



従来技術（シフタ方式）
第 6 図



従来技術（ターンテーブル方式）
第 7 図

PTO 03-4071

Japanese Kokai Patent Application
No. Hei 3[1991]-7003

LINEAR INDUCTION MOTOR CARRIER SYSTEM

Jun Senda

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Examination Request	Not filed

LINEAR INDUCTION MOTOR CARRIER SYSTEM

[Rinia yodo mota shiki hanso shisutemu]

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Applicant:	Sumitomo Heavy Industries, Ltd.

[There are no amendments to this patent.]

Claims /1*

1. A linear induction motor carrier system characterized in that it is equipped with a carrier cart having a structure comprising supporting rollers supported on reference surfaces and guiding rollers provided on guiding surfaces provided at a different height from that of the reference surfaces, a pair of linear induction motors provided on either side of the aforementioned structure, and a carrier provided below the reference surfaces while supported by the aforementioned structure;

* [Editor's note: Numbers in the right margin represent pagination in the original foreign language text.]

a carrier track having secondary conductors facing the respective linear induction motors, supporting members which support the supporting rollers at the reference surfaces as they come into contact with the supporting rollers, and magnetic secondary conductors for branching at a junction utilizing the electromotive force of a linear induction motor; and

junction part guiding members provided within the aforementioned guiding surfaces at the junction of the aforementioned carrier track which come into contact with applicable guiding rollers so as to generate a supporting force at least during the period in which the supporting rollers of the carrier cart are apart from the supporting members when the carrier track is branched.

2. The linear induction motor carrier system described in Claim 1 characterized in that the aforementioned carrier track has a structure which contains first horizontal members provided within the aforementioned reference surfaces while connected to the lower ends of said vertical members and second horizontal members provided within the aforementioned guiding surfaces while connected to the upper ends of said vertical members, the vertical members have secondary conductors facing the linear inductance motors, the upper horizontal surfaces of the first horizontal members constitute the supporting surfaces, and vertical inner end surfaces of the second horizontal members constitute the guiding surfaces.

Detailed explanation of the invention

Industrial application field

The present invention pertains to a carrier system utilizing linear inductance motors (LIM). In particular, it pertains to a carrier system in which a carrier cart travels on a carrier track containing junctions.

Prior art /2

A linear induction motor configured by cutting and unfolding an induction motor has a structure in which a primary coil serving as a power supply and a secondary conductor serving to receive the power are provided facing each other via a gap. A thrust is created by a traveling magnetic field generated by applying an AC current to the primary side and an eddy current generated on the secondary conductor by said traveling magnetic field. A conductor and a magnetic body are often combined to create the secondary side. Either the primary or the secondary side can be made movable when used for a pallet carrier device, for example. A shifter system and a turntable system, for example, are available as branching methods for a carrier system in which the carrier track contains junctions.

As shown in Figure 6, in the case of the shifter system, shifter 50 which can be moved laterally as illustrated in the figure is provided at a junction, and 2 or more kinds of branching

rails 51 and 52 are provided on it. For example, rail 53 is provided on one side of the shifter, and rails 54 and 55 are provided on the other side. When a carrier cart (not illustrated) travels between rail 53 and rail 54, shifter 50 is moved to the left so as to bring rail 51 on the right side of shifter 50 to the position between rail 53 and rail 54 in order to connect the rails together. To move from rail 53 to rail 55, shifter 50 is moved to the right in order to connect rail 53 with rail 55 using rail 52 on the left side of shifter 50. Although a case in which the numbers of the rails on either side of the shifter are 1:2 was shown above, in general, [the ratio] may be expressed as n:m. In terms of operation steps, the carrier cart is stopped as the carrier cart approaches the shifter, the shifter is moved to a desired position, and the carrier cart is driven again for the sake of safety.

Figure 7 shows a junction in the case of the turntable system. The rail provided on turnable table 60 can be connected to any of carrier track rails 61, 62, or 63 connected to table 60. Carrier cart 64 is placed on said table 60 once, and the direction carrier cart 64 travels is changed by turning said table 60. Although a case in which 3 rails meet at the junction part was shown above, arbitrary n kinds of rails may meet there. The carrier cart needs to be stopped on the table. Usually, the carrier cart is stopped at a point before the table, and it is led onto the table slowly.

Problem to be solved by the invention

With said conventional carrier cart branching methods, usually, the branching operation begins after the carrier cart is stopped before a junction part. In addition, in Figure 7, the time for the turntable to turn at the junction part is also needed. Thus, the operation cycle gets longer.

In addition, because the turning mechanism is provided inside of the junction part, if maintenance is needed, it will result in a cause of malfunctioning.

The purpose of the present invention is to present a linear induction motor carrier system by which the carriage at the junction part can be carried out promptly in order to reduce the operation cycle.

Another purpose of the present invention is to present a linear induction motor carrier system which does not required any turning mechanism inside of the junction part.

Means to solve the problem

In the linear induction motor carrier system of the present invention, the guiding surfaces are placed higher than the reference surfaces where the supporting rollers are supported, and the guiding rollers and the junction part guiding members are provided within the guiding surfaces. When the supporting rollers lose their support at a junction area along the carrier track, the guiding rollers in the guiding surfaces snap to the junction part guiding members to secure the support in order to prevent the carrier cart from falling off.

The basic concept of the present invention is illustrated in Figure 1 (A), (B), and (C).

For an explanation with reference to Figure 1 (A), in the normal condition, the carrier system has carrier cart 1 having frame 9a, linear induction motors 2a and 2b provided on either side of it, supporting rollers 4a and 4b supported by frame 9a, and guiding rollers 3a and 3b and carrier track 10 having secondary conductors 5a and 5b facing the respective linear induction motors, supporting members 7a and 7b which support supporting rollers 4a and 4b, and guiding members 6a and 6b in contact with guiding rollers 3a and 3b. Furthermore, although they are not illustrated, it is assumed that supporting rollers 4c and 4d are provided in the rear of supporting /3
rollers 4a and 4b, and guiding rollers 3c and 3d are provided in the rear of guiding rollers 3a and 3b.

Furthermore, at a junction area of carrier track 10 of the kind shown in Figure 1 (B), no supporting member can be provided at the part indicated by the broken line in order to allow coupling member 9c of branching carrier cart 1 to pass. As such, if it is kept the way it is, one of the supporting roller, for example, 4b, of the carrier cart loses its support, and carrier cart 1 ends up falling off.

As shown in Figure 1 (C), junction part guiding member 8b is provided within the guiding surface placed higher than the reference surface, so that carrier cart 1 makes contact with guiding roller 3b provided on the opposite side to the branching direction when it is branched to carrier track 10b. Similarly, junction part guiding member 8a is provided for branching to carrier track 10c.

It is preferable that carrier track 10c has carrier track members each having a]-shaped or I-shaped cross section comprising vertical members 5a and 5b and upper horizontal members 6a and 6b and lower upper horizontal members 7a and 7b connected to the upper and the lower ends of said vertical members; vertical members 5a and 5b have conductors facing linear induction motors 2a and 2b; upper surfaces of lower horizontal members 7a and 7b form the surfaces for supporting supporting rollers 4a and 4b; and the end surfaces of upper horizontal members 6a and 6b form the surfaces for guiding guiding rollers 3a and 3b.

Function

In reference to Figure 1 (B), to let carrier cart 1, which has traveled downward on carrier track 10a configured with the aforementioned carrier track member to a point before the junction, advance to one of the branching directions (for example, to carrier track 10b provided on the left side in Figure 1 (B)), while linear induction motor 2a in the branching direction in Figure 1 (A) is being exited, excitation of linear induction motor 2b provided on the opposite side is cut off. Excited linear induction motor 2a generates a thrust and an electromotive force in order to direct carrier cart 1 in the direction of secondary conductor 5a (to the left in the figure). As such, as

shown in Figure 1 (C), carrier cart 1 moves along secondary conductor 5a provided on the left at the broadened junction part.

Because the supporting members of the carrier track are cut off within the intersection, the supporting rollers lose their support there. However, because guiding members 8a and 8b provided within the guiding surfaces placed at a different height from that of the reference surfaces come into contact with guiding rollers 3a and 3b to provide a supporting force, carrier cart 1 is sustained. In the case illustrated here, guiding roller 3b comes into contact with junction part guiding member 8b before supporting roller 4b provided on the right front side comes off supporting member 7b. After front guiding roller 3b snapped to junction part guiding member 8b, supporting roller 4b loses its support. In addition, guiding roller 3d comes into contact with junction part guiding member 8b before supporting roller 4d provided on the right back side loses its support. Carrier cart 1 travels from carrier track 10a to carrier track 10b in said manner. In the meantime, guiding rollers 3b and 3d on the right and supporting rollers 4a and 4c on the left are mostly in contact with junction part guiding member 8b and supporting member 7a, respectively.

Carrier cart 1 can be designed as such that it never falls off unless the contact between supporting rollers 4b and 4d and supporting member 7b and the contact between guiding rollers 3b and 3d and the guiding surface of junction part guiding member 8b are completely lost.

In addition, it can be also designed such that at least 2 of the aforementioned 4 contacts can be maintained. The gaps between upper horizontal members 6 and junction part guiding members 8 can be reduced by reducing the size of the guiding rollers.

Application example

An application example of the present invention will be explained below with reference to the figures.

Figure 2 (A) and (B) illustrate the carrier cart used for the linear induction motor carrier system of the application example of the present invention, Figure 2 (A) is a front view of Figure 2 (B) along line IIA-IIA indicated by the arrows, and Figure 2 (B) is a plan view of Figure 2 (A) along line IIB-IIB indicated by the arrows. In the figures, the carrier system includes carrier cart 11 and carrier track 10, and carrier cart 11 travels along carrier track 10 in order to carry items, such as parts (not illustrated).

Carrier cart 11 has frame 19a, linear induction motors (LIM) 12a and 12b provided on either side of frame 19a, carrier 19b for carrying items, such as parts, and coupling member 19c for hanging carrier 19b from frame 19a. Linear induction motors 12 each contains a magnetic core made of iron and a coil and generate a traveling magnetic field as they are driven using a 3-phase AC current. Supporting rollers 14 with a large diameter which provide the primary supporting force are provided at the lower part of frame 19a, upper guiding rollers 15 with a

/4

small diameter are provided at the top, and lower guiding rollers 16 with a small diameter are provided at the bottom similarly in order to define its position in the horizontal direction accurately. As is clear from the plan view in Figure 2 (B), 4 each of these supporting rollers 14 and guiding rollers 15 and 16 are provided in all directions of carrier cart 1 [sic; 11].

Carrier track 10 has 2 I-shaped members 30a and 30b having an I-shaped cross section. I-shaped members 30a and 30b have vertical members 25a and 25b and 2 upper horizontal members 26a and 26b and [2] lower horizontal members 27a and 27b fixed to the top and the bottom of said vertical members 25a and 25b, and upper horizontal members 26a and 26b are fixed to rack 35. Vertical members 25a and 25b are provided with a conductor made of aluminum, for example, and a magnetic body made of iron, for example, and placed to face linear induction motors 12a and 12b so as to constitute secondary conductors of linear induction motors 12a and 12b. Furthermore, although vertical members 25 do not have to contain magnetic bodies, they need at least to have a magnetic material, such as iron, in order to generate an electromotive force near the junction area.

Supporting roller 14 of carrier cart 11 are supported by upper surfaces 24a and 24b of lower horizontal members 27a and 27b of I-shaped members 30 so as to support carrier cart 11. In addition, upper guiding rollers 15 are in contact with inner end surfaces 28a and 28b of upper horizontal members 26a and 26b, and lower guiding rollers 16 are in contact with inner end surfaces 29a and 29b of lower horizontal members 27a and 27b in order to maintain the gaps between linear induction motors 12 and secondary conductors 25 constant.

Carrier cart 11 is further provided with a collector device and a controller device not illustrated. The collector device takes in an AC voltage through a trolley line (not illustrated) provided to carrier track 10 or I-shaped members 30.

Furthermore, although a case involving I-shaped members having an I-shaped cross section was explained above,]-shaped members may be placed to face each other in place of the I-shaped members. Similarly, a structure in which horizontal members are provided at the top of vertical members while protruding to either side, and horizontal members protruding only inward are provided at the bottom may also be utilized.

In the case of the present application example, because the guiding members are provided at the top as well as at the bottom, movements of the carrier cart can be stabilized.

When a structure in which the supporting surfaces of the carrier track are cut off at a Y-shaped junction, for example, in order for the carrier cart to pass, and the carrier cart loses its support partially at the cut-off part is adopted the supporting force can be secured by snapping the upper guiding rollers to the end surfaces of the upper horizontal members, so that the carrier cart can be prevented from falling off as will be explained later.

Figure 3 (A) and (B) and Figure 4 (A) and (B) illustrate an embodiment of the junction part of carrier track 10. Figure 3 (A) and (B) are front cross sectional views along lines IIIA-IIIA and IIIB-IIIB indicated by the arrows in Figure 4 (A) and (B). Figure 4 (A) and (B) are plan cross sectional views along lines IVA-IVA and IVB-IVB indicated by the arrows in Figure 3 (A) and (B).

Figure 3 (A) is a vertical cross sectional view of a part involving a single carrier track, and Figure 3 (B) is a vertical cross sectional view of a junction part. I-shaped members 30a and 30b are separated so as to broaden the gap between them as [the carrier cart] approaches the junction part. At the junction part, junction part guiding members 36 and 38 are provided within guiding surfaces demarked by upper horizontal members 26a and 26b. Junction part guiding surfaces 37 and 39 to be brought into contact with upper guiding rollers 15 of carrier cart 11 are formed on their side surfaces in order provide support.

Figure 4 (A) is a plan view when looking downward from the guiding surfaces within the upper horizontal members as indicated by the IVA-IVA line in Figure 3 (A) and (B) . Carrier tracks 10b and 10c are branched out from carrier track 10a, upper horizontal members 26a and 26b are separated gradually, and upper horizontal members 26c and 26d are provided newly. Aforementioned junction part guiding members 36 and 38 are provided within the junction part. These junction part guiding members are used to achieve a function equivalent to that of the upper horizontal members at the part where the upper horizontal members disappear. /5

Figure 4 (B) is a plan view when looking downward from the intermediate surface along the IVB-IVB line in Figure 3 (A) and (B); wherein, the shapes of the supporting surfaces of the lower horizontal members are shown. Lower horizontal members 25 have the same shapes as those upper horizontal members 26. An empty space is created at the center of the junction part in order to allow a member, such as coupling member 9c shown in Figure 2 (A), to pass, so that members corresponding to the junction part guiding members shown in Figure 4 (A) can not be provided there.

Next, in reference to Figure 5 (A), (B), and (C), operations of the carrier system with the aforementioned configuration to be carried out when carrier cart 11 is branched from carrier track 10a configured with I-shaped members 30a and 30b to carrier track 10c configured with I-shaped members 30d and 30b [sic.; 30c] will be explained.

As carrier cart 11 has traveled on carrier track 10a to reach a point just before the junction part, while the linear induction motor (refer to 12b in Figure 1 (A) and (B)) in the branching direction is kept excited, excitation of the linear induction motor (refer to 12a in Figure 1 (A) and (B)) on the other side is cut off. As a result, as shown in Figure 5 (A), excited linear induction motor 12b generates a thrust and an electromotive force in order to direct carrier cart 1 [sic; 11] downward. Guiding roller 15a provided at the front right side is separated from the guiding

surface of I-shaped member 30a and brought into contact with junction part guiding member 36 immediately. The positions supporting rollers 14 and guiding rollers 15 are designed such that supporting roller 14a provided at the front right side is not yet separated from supporting surface 30a when guiding roller 15a comes into contact with junction part guiding member 36.

As carrier cart 11 advances while its weight is supported by guiding roller 15a provided at the front right side, as shown in Figure 5 (B), guiding roller 15c provided at the rear right side is separated from the guiding surface of I-shaped member 30a and brought into contact with junction part guiding member 36 immediately.

Next, as shown in Figure 5(C), guiding roller 15a provided at the front right side comes into contact with the guiding surface of I-shaped member 30d, and carrier cart 11 enters carrier track 10c. Finally, guiding roller 15c provided at the rear right side comes into contact with the guiding surface of I-shaped member 30d. As a result, carrier cart 11 enters completely into carrier track 10c configured with I-shaped members 30b and 30d. In the meantime, guiding rollers 15b and 15d and supporting rollers 14b and 14d provided on the left side remain in contact with the guiding surface and the supporting surface of I-shaped member 30b, respectively. Carrier cart 1 can travel through the junction part without falling out in said manner.

Although the present invention was explained above based on the application example illustrated in the figures, the present invention is not restricted to said [application example, and it can be modified in a variety of ways without going beyond the scope described under Claims.

For example, although the carrier track was configured with 2 I-shaped members, it may be configured using 2]-shaped members or members with a different structure also. Although a case in which supporting rollers were utilized as a means for supporting the carrier car was explained, other supporting systems, for example, air bearings and magnetic bearings, may be utilized also.

In addition, although a case in which guiding rollers 15 and 16 were provided at frame 19a of the carrier cart was explained, they may be provided directly at linear induction motors 12. Although a hanging rack type was introduced as a system for supporting carrier 19b, a built-in type may also be utilized.

Effect of the invention

With the linear induction motor carrier system of the present invention, because there is no need to stop the carrier cart at a point before or within the junction area of the carrier track, the carrier cart can pass through the junction area quickly, so that the operation cycle can be reduced.

In addition, because there is no moving part involved at the junction area, the carrier cart can travel though the junction area reliably without requiring any maintenance.

Brief description of the figures

Figure 1 (A), (B), and (C) are diagrams illustrating the basic concept of the present invention; wherein, Figure 1 (A) and (C) are front views of the normal condition and the branching condition, and Figure 1 (C) is a plan view of the junction part.

Figure 2 (A) and (B) are diagrams showing the carrier cart used for the carrier system in the application example of the present invention; wherein, Figure 2 (A) sis a front view, and Figure 2 (B) is a plan view.

Figure 3 (A) and (B) illustrate the cross sectional structure of the carrier track; wherein, Figure 3 (A) is a cross sectional view of the single carrier track part, and Figure 3 (B) is a cross sectional view of the junction part. /6

Figure 4 (A) and (B) illustrate the planar structure of the carrier track; wherein, Figure 4 (A) is a plan view of the guiding surface, and Figure 4 (B) is a plan view of the supporting surface.

Figure 5 (A), (B), and (C) are outline plan views of 3 conditions for illustrating the operations of the carrier cart when it passes through the junction part.

Figure 6 is a plan view illustrating an example branching system of a conventional carrier device.

Figure 7 is an oblique view illustrating another example of the conventional branching system.

In the figures,

1 Carrier cart
2 LIM
3 Guiding roller
4 Supporting roller
5 Secondary conductor (vertical member)
6 Guiding member (upper horizontal member)
7 Supporting member (lower horizontal member)
8 Junction part guiding member
9a Frame
10 Carrier track
11 Carrier cart
12 LIM
14 Supporting roller
15 Upper guiding roller
16 Lower guiding roller

19a Frame
19b Carrier
25 Vertical member
26 Upper horizontal member
27 Lower horizontal member
28, 29 End surface (guiding surface)
35 Rack
36, 38 Junction part guiding member

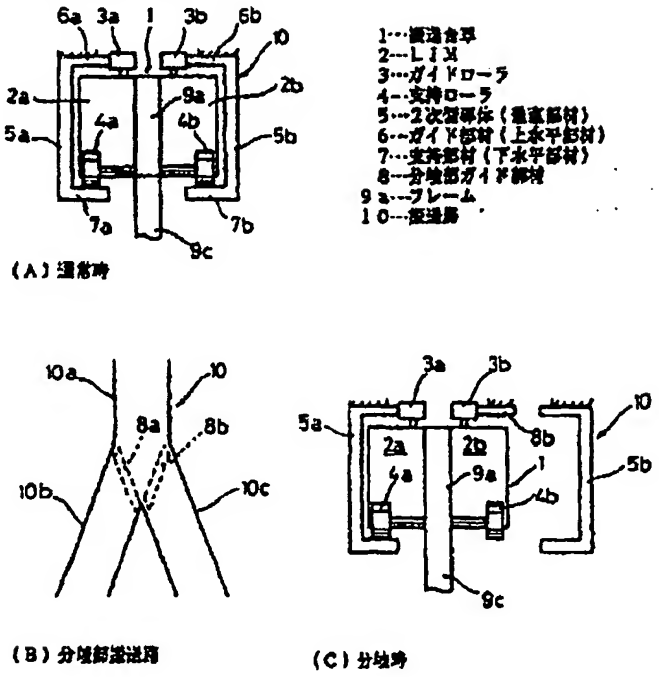

Figure 1. Basic concept of the present invention

Key: (A) Under the normal condition
(B) Carrier track at junction part
(C) During branching
1 Carrier cart
2 LIM
3 Guiding roller
4 Supporting roller
5 Secondary conductor (vertical member)
6 Guiding member (upper horizontal member)
7 Supporting member (lower horizontal member)
8 Junction part guiding member
9a Frame
10 Carrier track

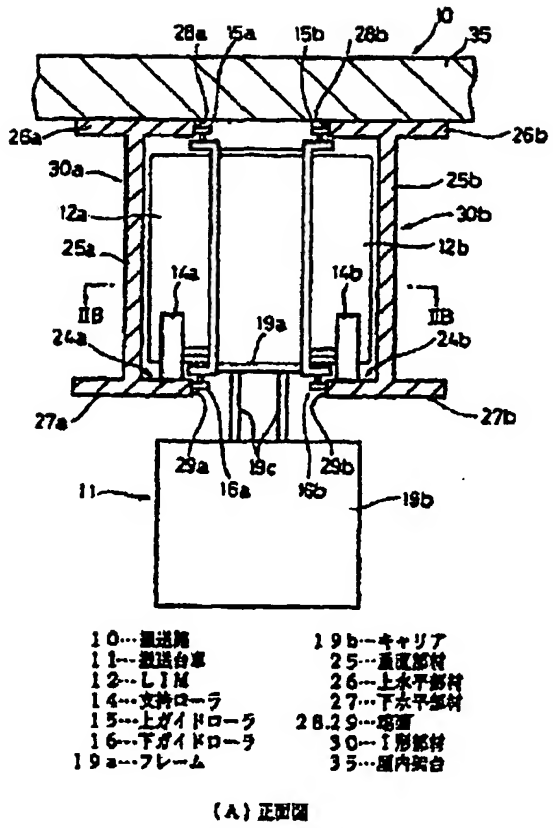

Figure 2 (Part 1). Carrier cart in accordance with the application example of the present invention

Key:
(A) Front view
10 Carrier track
11 Carrier cart
12 LIM
14 Supporting roller
15 Upper guiding roller
16 Lower guiding roller
19a Frame
19b Carrier
25 Vertical member
26 Upper horizontal member
27 Lower horizontal member
28, 29 End surface
30 I-shaped member
35 Rack

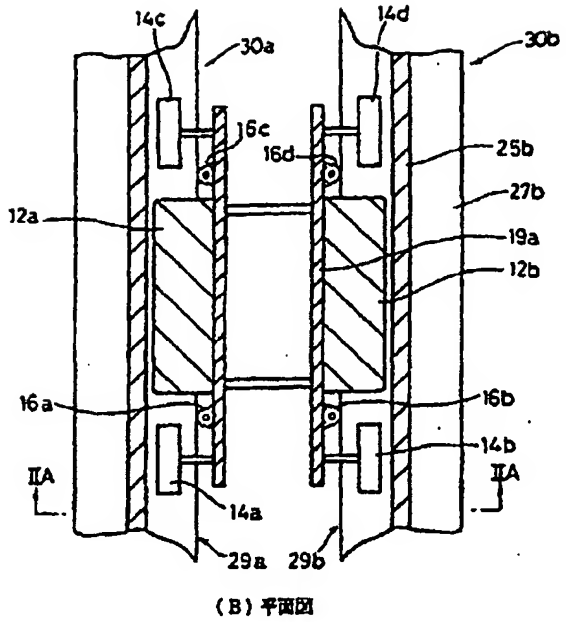

Figure 2 (Part 2). Carrier cart in accordance with the application example of the present invention

Key: (B) Plan view

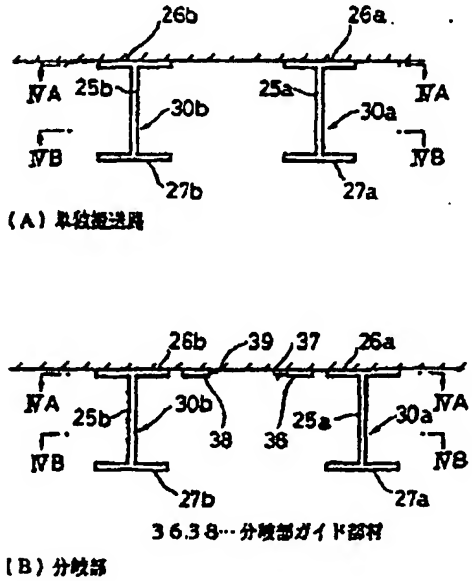

Figure 3. Cross sectional structure of carrier track

Key: (A) Single carrier track
(B) Junction part
36, 38. Junction part guiding member

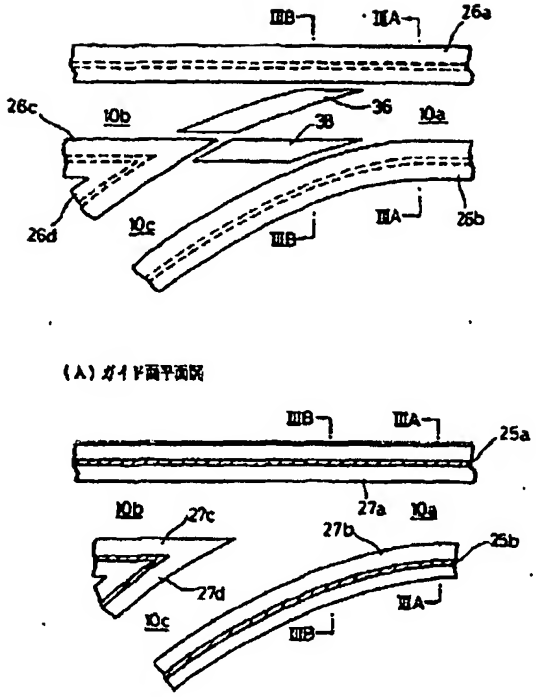

Figure 4. Planar structure of carrier track

Key: (A) Plan view of guiding surface
(B) Plan view of supporting surface

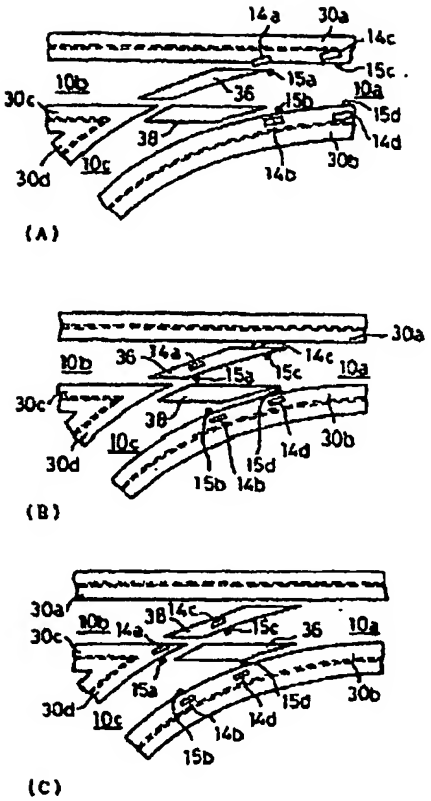

Figure 5. Support for carrier cart at junction

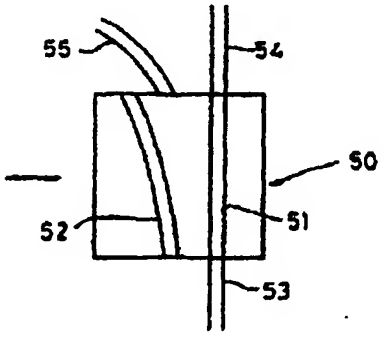

Figure 6. Prior art (shifter system)

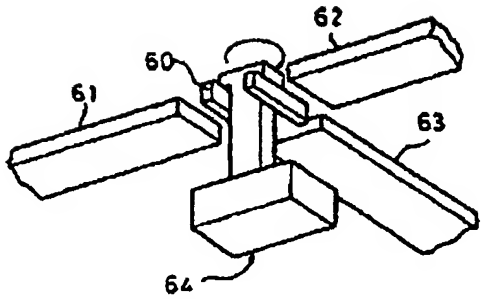

Figure 7. Prior art (turntable system)